The C2 Requirements Process: An Acquisition View

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Presented by
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4 October 2000

What is a Requirement?

Process

Note the initial emphasis on "broad operational capability"

- **CJCSI 317(**
  - **The need of a operational user, initially expressed in broad operational capability terms in the format of a MNS. It progressively evolves to system-specific performance requirements in the ORD**

- **AFI 10-601**
  - **A recommended solution to a mission deficiency that when validated and approved, justifies the timely allocation of resources to achieve capability to accomplish military objectives,**

Note the emphasis on "recommended solution"

Why Change?

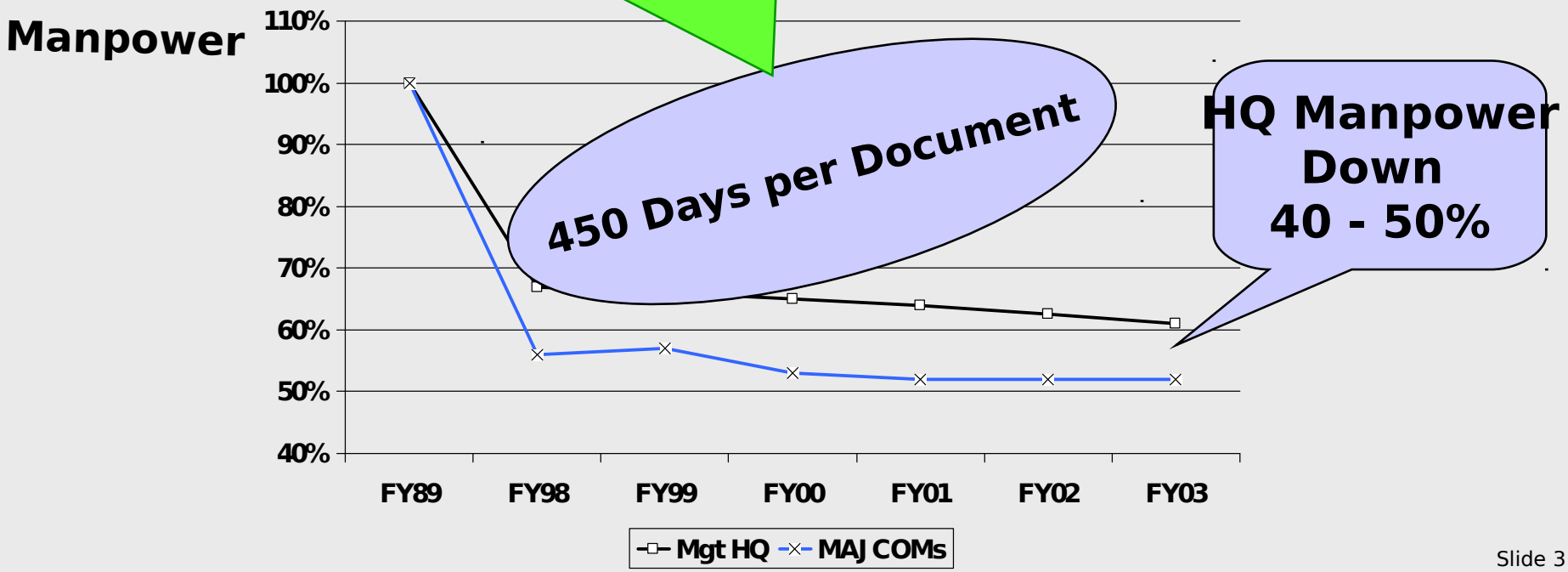
Requirements Process

Information technologies will experience one or two generations of change in this period

gned for Different

nged

ligned with pace



The Current Process

Requirements Process

No part of this process is compatible with the pace of technology or the experience of internal IM/IT development in commercial companies

FAR/DFAR
DoD 5000.1
DoD 5000.2

Docs/yr
0+ People

2+ yrs

1.5 yrs

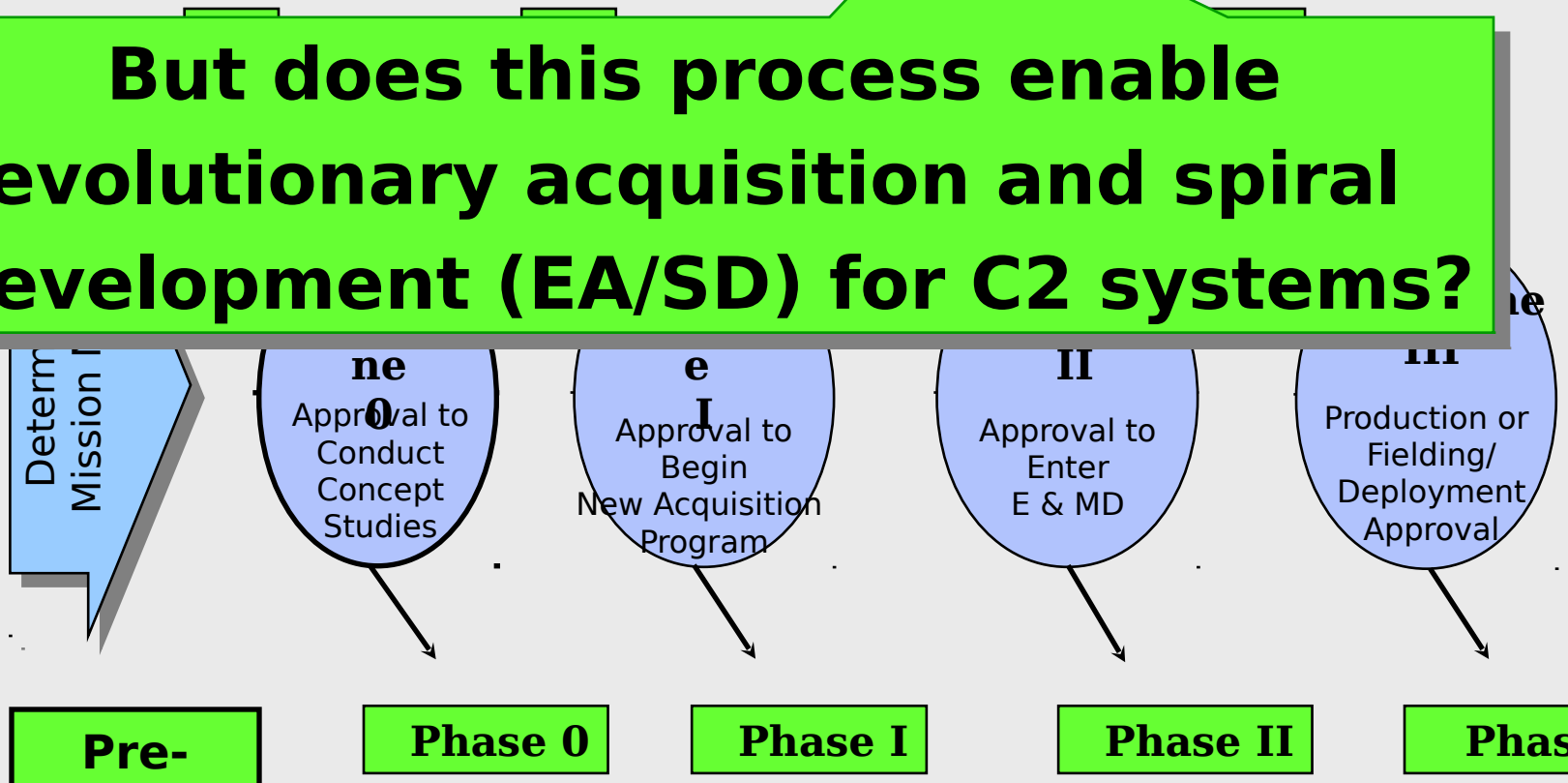
Acquisition Process
10+ yrs

Programming & Budgeting Processes 2yrs

Milestones & Phases: The 5000 Process

Requirements Process

But does this process enable evolutionary acquisition and spiral development (EA/SD) for C2 systems?



Pre-Phase 0 Activity	Phase 0	Phase I	Phase II	Phase III
	Concept Exploration	Program Definition & Risk Reduction	Engineering & Manufacturing Development	Production, Fielding/Deployment, and Operational Support
Planning	Requirements Generation		Acquisition	

A BASIC ASSERTION

- **The Air Force process, as summarized above, for defining, developing, acquiring, and fielding information systems, whether Command and Control, Combat Support, or business and administrative, is completely out of touch with the pace of the commercial Information Technology (IT) world.**

Fundamental changes are required in the "requirements" process (writ large)

CONTEXT FOR THIS PRESENTATION

- **Discussion based on presentation to SAB on April 23, 2000, Nellis AFB, Nevada**
  - **AF C2 must become web enabled (ic2.com)**
  - **AF Vision for Integrated Command and Control has two "architectural layers"**
    - **Mission and domain applications**
    - **Integrated IT infrastructure that services**
      - **Combat operations**
      - **Combat support**
      - **Business and functional operations**

ny of the changes that are required apply to both laye

special attention is given to the infrastructure layer.

PURPOSE OF THIS PRESENTATION

- ~~**Make recommendations for changes which will**~~ *Set out elements of process*
  enable the C2 Vision to be achieved in the near term to include
  - **requirements, as developed today, replaced by "concepts of operation" and "desired capabilities", referred to as "desirements"**
  - **new funding approaches, particularly for the infrastructure, that enable more rapid fielding of capabilities**
  - **process implementations in DOD Series 5000 that enable evolutionary acquisition using spiral development (EA/SD)**
  - **centralized responsibility and management of the**

But first consider some important lessons from the commercial world through some Harvard Business School case studies

SOME CASE STUDIES

How does the AF Vision for integrated C2 relate to good practice in the commercial industry?

CISCO SYSTEMS, INC.

HBS 9-398-127, October 13, 1998

- **Cisco has a centralized functional organization with three "lines of business"**
  - **analogous to AF MAJCOMs**
  - **the business lines have no responsibility for several centralized functions, including IT, finance, and human resources**
- **CIO, Peter Sorvik, proposed and built an "Enterprise Resource Planning System" for which he says:**

  "In a two year period (sic, $100M), we literally replaced every piece of technology in the company. We have a very low-cost/high-value technology architecture. We have no mainframes, no mini computers, and no legacy technology. Everything is current."

CISCO SYSTEMS, INC. -2

- **The IT platform is stand** *Process*
  throughout Cisco
  - **e to m ket, reduced**
    tegr tion, and a high

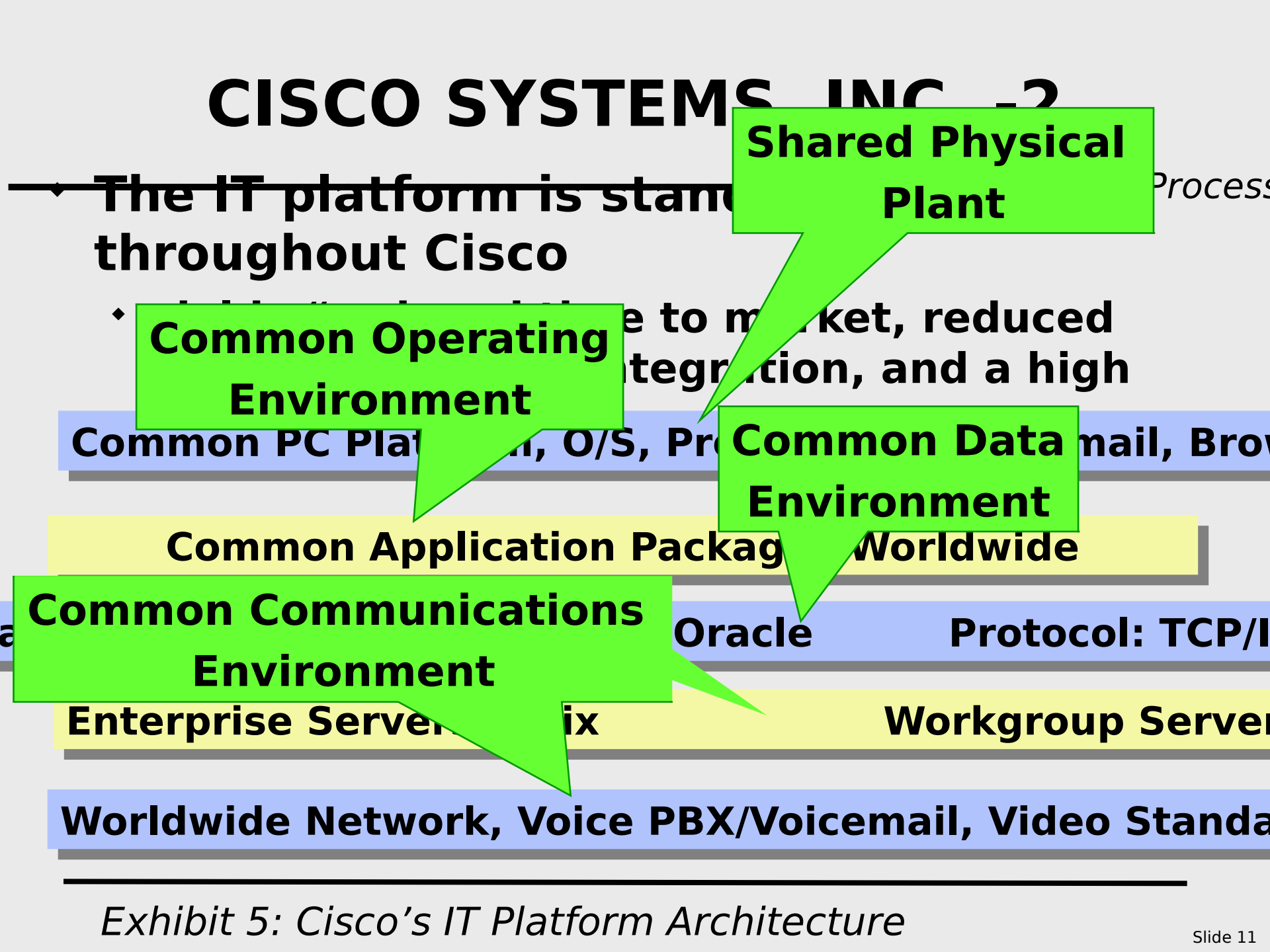


Exhibit 5: Cisco's IT Platform Architecture

CISCO SYSTEMS, INC. -3

- **Web enabled using the Netscape browser**

  "When we purchased our applications, none were web enabled. We had to web enable them all. So we did that with a standard set of tools and a smart group of people."

- **Cisco customer, partner and supplier interactions are network based**
  - **begin at Cisco's Home Page**
  - **navigation done by "publish and subscribe"**
- **Cisco has built its own global intranet**
  - **allows global interaction within the company**
  - **provides a "proving ground" for new technologies and products**
- **A Cisco study showed the centralized IT development saves as much or more than the actual costs (I.e., effectively the IT is "free")**

OBSERVATIONS

Requirements Process

- **Cisco has implemented their decision support using a model very similar to the AF Vision**
- **Other companies, including Xerox, Sears, and Symantec reached similar conclusions (References)**

or more information about the Cisco solution, click here
For summaries of the other companies, click
Xerox
Sears
Symantec

SUMMARY OF T UDIES

- **Each of these d nies came to the con**
  - **a centrally developed infrastructure, governm architecture and indu s necessary**
  - **stem is network-based and web enabled**
  - **information management building common acces heterogeneous sou s, “publish and subscribe” model**
  - **business units must use the infrastructure but develop their own applications as well as identify infrastructure deficiencies and provide**

Centralized management of infrastructure

A Global Grid Using Internet Standards

Build the JBI

Applications must conform to infrastructure

onclusion: These represent general principles appropriate for use by the AF

ls fo

Operators, supporters, functionals must address interoperability desires

Infrastructure will provide integration

- Provide Integrated and
  bilit

Existence of infrastructure enables rapid fielding

Infrastructure rides the commercial marketplace

- Reduce the Time to Field Capabilities

- Leverage the Burgeoning

For this presentation, C2 encompasses all nformation Management (IM) and Information Technology (IT) applications to include Combat erations & Battle Management, Combat Suppo and business and administrative functions

To Realize the “Goals for AF C2”

Requirements Process

- **To achieve their version of the same goals, the experience of private corporations shows the need for the creation of a centrally-managed IM/IT infrastructure**

What are the hindrances in the AF and DOD to creating the commercial solution?

SUMMARY OF INITIAL OBSERVATIONS

Requirements Process

- **The development of requirements is “hard-broke” for C2 in the existing commercial IT environment (see Requirements)**
- **In addition to requirements, the planning, funding (PPBS), and acquisition processes are incompatible with the C2 needs (see Process)**
- **Although DOD Series 5000 is being revised, do the changes enable the use of EA/SD as needed for realization of the C2 Vision? (see 5000 Series)**
- **Given the definitions for requirements (see Definition or Reasons), who states the requirements for a common infrastructure for C2? Difficult to imagine it being defined by a MAJCOM (I.e., a business unit)**

First,

view DOD Series 5000 in the context of a Spiral Proce

Is the Spiral Process within EA/SD Enabled in the New DOD Series 5000?

Key Characteristics of the Spiral Process

Requirements Process

- **Iterative throughout life cycle**
  - **Intended to be used within Evolutionary Acquisition blocks**
- **Emphasis on rapid delivery**
  - **Performance traded for cost and schedule control**
  - **Utilizes COTS solutions**
- **Requirements flexibility built into business and technical strategies, e.g.,**
  - **Continuous user and tester involvement**
  - **Flexible architecture**
- **Experimentation integral to Spiral process**
- **Decision points**
  - **Stop, continue, change, field and support**

Needed to realize the C2 Vision but seems dissonant with the 5000 definitions given in Chart 5. However, ...

5000 Acquisition Phase and Spiral Process Goals

Requirements Process

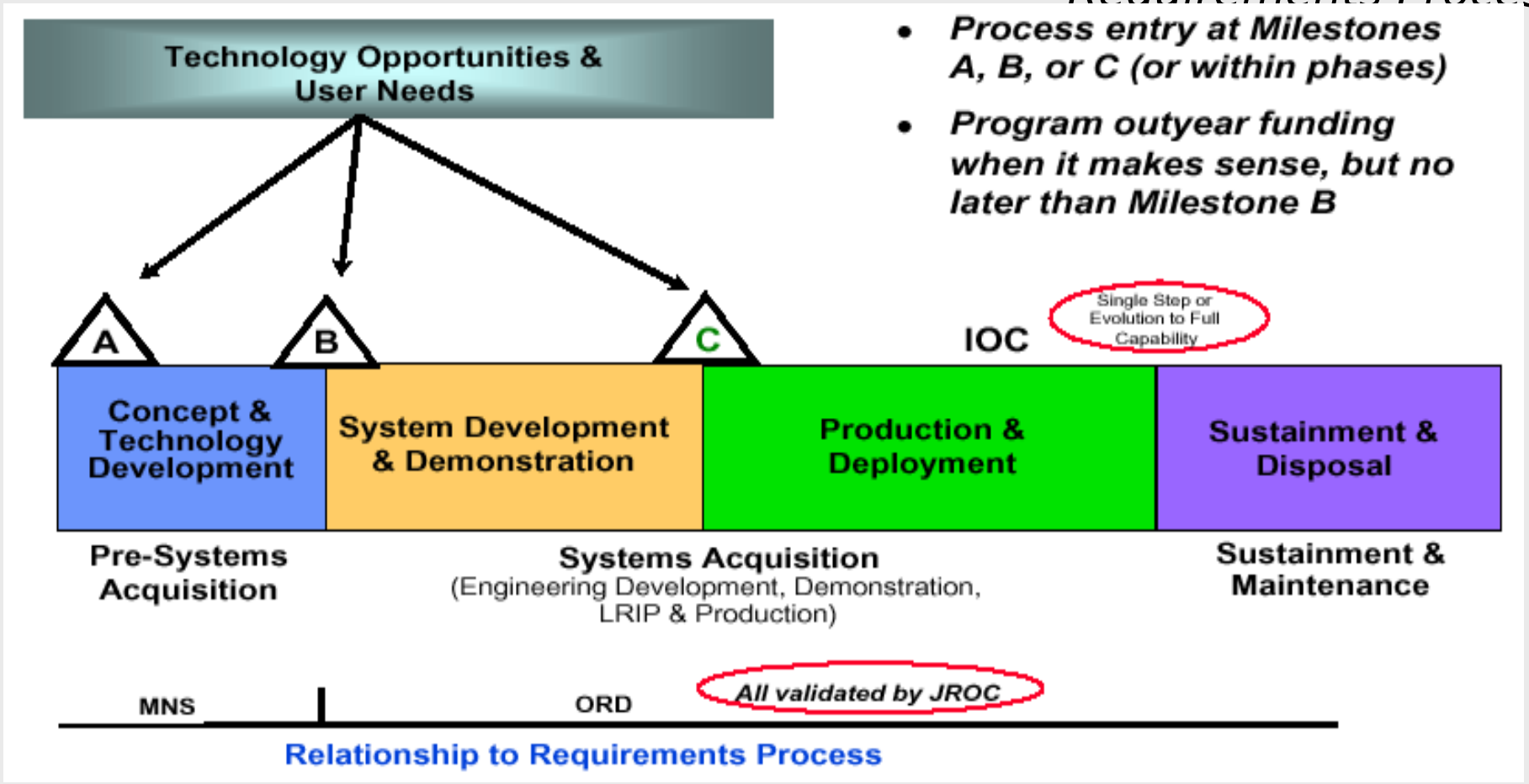
- **5000 process**
  - **Mature the technologies**
  - **Demonstrate operational effectiveness**
  - **Ensure affordability**
  - **Ensure supportability**
  - **Provide capability in shortest practical time**
  - **Manage and control risk**

- **Spiral process**
  - **Transition technologies**
  - **Demonstrate operational effectiveness**
  - **Control cost**
  - **Ensure supportability**
  - **Provide capability in shortest practical time**
  - **Manage and control risk**

5000 process and spiral process have the same goals

Process in "New" 5000.1 Instruction

Requirements Process



But what conclusions follow?

"New" 5000 Process and EA/SD Process
~~A Contrast~~ *Requirements Process*

- **5000 process**
  - **Formal phases with major milestones and decision points**
  - **Evolutionary acquisition is preferred strategy but not shown in the process**
  - **Each EA increment (block) delivers a product to the field**
  - **Each EA block requires prior approval of requirements**

- **EA/SD process**
  - **Decision points within and at end of spiral are informal**
  - **Spirals are within an EA increment**
  - **Outcome of a spiral does not have to be a delivery to the field**
  - **Spirals can influence requirements**
  - **Can be concurrent spirals with different goals, schedules**

Are there any Barriers to EA/SD?

Requirements Process

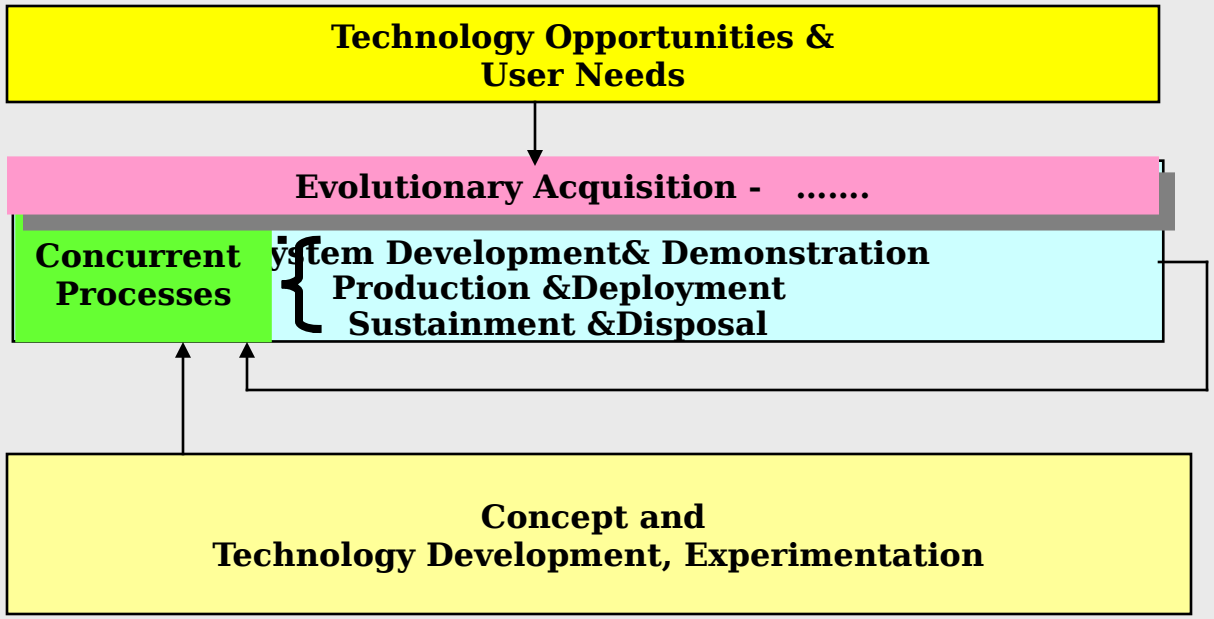
- **No barriers in the words of 5000 that prevent spiral or Evolutionary acquisition**
  - **Encourages all desired characteristics of spiral**
- **But emphasis in words, not in process**
- **Need to determine when approval is needed for requirements changes**
  - **Depends on level of detail in ORD**
  - **Presently, ORD approval time is long,**

ocess still seems serial and hardware oriented! Can t AF implement a process that satisfies the words but enables the spiral process?

A Proposed 5000 Model Evolutionary Acquisition: Continuous Evolution

Requirements Process

The C2 infrastructure can only be developed and sustained using this process as amended below



The boundaries between process stages must be eliminated to accept rapid change

Acquisition Environment

Some Realities and Issues that Must Be Faced

The AF Is Directing Change

Requirements Process

- **1990’S - 1997**
  - **PEO Structure**
  - **Buy Commercial**
  - **Eliminate Restrictions**
- **1997 C2 Summit**
  - **Manage C2 as a Weapon System**
  - **Created AC2ISRC**
  - **Implement EA & Spiral Development**
  - **Expeditionary Force Experiment(EFX)**

Status

- **Not working - still not getting integrated capability fielded rapidly**
- **Are there barriers caused by**
  - **limitations inherent in organizational structure?**
  - **AF inability to deal with commercial products and technologies?**
  - **the current implementation of the acquisition process?**

Issues

Issue - Guidance

Requirements Process

No overarching management of MAJCOM or functional organization's C2 processes:
- **-- Planning**
- **-- Top-down guidance**
- **-- Technology insertion**
- **-- Industry inputs**

Cross-cutting issues difficult to address

No AF prioritized list of capability shortfalls

Case studies showed that industry has centralized management and development of their IT infrastructure

Issue - Infrastructure Requirements

Requirements Process

- **Currently, no organization has taken ownership of the infrastructure development**
  - **AC2ISRC, AFCIC, and AFMC/ESC all have some interest but none have been able to generate support**
  - **Infrastructure should be invisible to MAJCOMs and user/operators**
  - **Properly designed, the Global Grid and the Joint Battlespace Infosphere will provide the same benefits to AF and DOD as the companies in the studies achieved from their infrastructure**

The infrastructure is above all a technical development challenge and must support operational capabilities

Issue - Time to Market

- **Current implementation of the requirements process doesn't satisfy first order needs in any IT market environment**
  - **Process is cumbersome, bureaucratic and time consuming**
  - **Windows of opportunity are lost**
  - **Getting minor changes which have large impact are not capitalized on**
  - **Funding vehicles are not flexible**
  - **Regulatory constraints ties our hand**
  - **No effective method to accommodate technology insertion**

Without fixing these problems, AF C2 will not achieve the goals stated above.

Issue - Technology Leader

- **Fast moving technology developments with commercial sector leading developments in IT**
  - **Everyone, friend and foe, has access to same technology**
  - **We need to keep up, as a minimum, with a strong desire to stay ahead**
    - **Our own technology will be used against us.**
  - **We need to be able to buy things as a pure “consumer” (I.e., whip-out our**

What will it take to purchase and apply the required commercial technologies quickly?

Issue - General

- **Current process lacks “trust”**
  - **Excessive coordination**
  - **Requirement statements too detailed**
  - **Program Element (PE) definitions are too narrowly defined - hard to move money in many cases**
- **Inflexible process**
  - **“One-size-fits-all” process not viable**
  - **Program Management Direction needs to enable integration**

How can the Air Force change to resolve these issues?

RECOMMENDATIONS

RECOMMENDATION - 1

Requirements Process

- **To realize the AF Vision of integrated C2, requirements definition needs to be changed dramatically**
  - **the C2 concept of operations, mapped into desired operational capabilities, should drive C2 development**

The desired capabilities are referred to as "desire

(emphasizes the change from the term "requirem

- **Desirements need to be developed through dire interactions of "operators" and "acquirers"**
- **The desirements must define the capabilities but CANNOT define how the capability is obtained (what not how!)**

Generally, it is expected that desirements will change infrequently

RECOMMENDATION - 2

- **Program Elements need to be redefined more broadly, preferably in terms of the desired capabilities (I.e., desirements)**
  - **PEs should be defined in two general classes**
    - **operational/functional capabilities**
    - **infrastructure capabilities**
  - **Capability-based PEs should add flexibility to the manner in which appropriated funds are spent**
- **There needs to a C2 Capstone Program Management Direction (CPMD) document and**
  - **PMDs for each PE should support CPMD and should enable PMs to expend funds in a manner best suited to achieve the**

hese steps should provide PMs with greater flexibility in responding to changes in operator emphases

implemented, this recommendation should fr

C2 development from many of the restrictions

- **infrastructure**
  - **In accordance with Clinger-Cohen Act, the CIO is a reasonable choice**
  - **The C2IO should establish policies and standards directed to the MAJCOM and functional organizations**
    - **to empower necessary business process changes**
    - **to ensure integration of new system developments**
  - **The creation of the C2 infrastructure should be distinguished from the R&D process and regarded as a AF "business need"**
    - **3080 or 3400 money (or a new color of money for IT infrastructure, say 3700) seems more compatible with the need to rapidly evolve the infrastructure rapidly**
  - **Invest initially in the infrastructure based on the industry experience.**
  - **Responsibility for executing the creation and evolution of the C2 infrastructure under the CIO**

Building the infrastructure will ONLY involve "developed" infrastructure capabilities

RECOMMENDATION - 4

Requirements Process

- **For the creation of operational and/or functional C2 capabilities, whether using the DOD Series 5000 process or "homegrown", the AF must require that**
  - **all fielded developments will satisfy the infrastructure policies and standards**

latforms, airborne or spaceborne, as well as ISR syst
all types, need to be compatible with the infrastructu
n order to make their data/information widely availab

RECOMMENDATION - 5

- **Replace the "Predictive Banking" process of** *Requirements Process*
  the PPBS system for developments that are based primarily on commercial IT capabilities, including enhancements to the infrastructure
  - **The use of desirements/desired capabilities should provide more flexibility in the application of funds**
  - **3080 or 3400 money (or "3700") seems more compatible with the need to rapidly evolve, modernize, and sustain the infrastructure and IT-rich applications**
- **Create a "discovery" pot of money (I.e., a PE**
  experimentation of any other source
- **Create "credit cards" to fund IT projects by business area, including the infrastructure, to enable the timely investment of new IT capabilities**
  - **Must ensure that this satisfies requirements of**

These last two items provide a mechanism for "non-predictive (or "flexible predictive) banking

RECOMMENDATION - 6

Requirements Process

- **Implement the DOD Series 5000 for IT-intensive C2 systems using the process defined above**
  - Indicates need for iteration to maintain flexibility
  - Recognizes sustainment of evolving and legacy systems is input to the next iteration
  - Encourages flexibility in requirements throughout the life cycle
- **Specify ORD at high enough level (create desirements) so changes and approvals are not required before every EA block begins**
  - Avoid specifying design in ORD
- **Experimentation, concept and technology development should occur continuously and in parallel throughout life cycle of the**

The C2IO must work proactively with DOD to ensure that DOD Series 5000 meets the needs of the AF

RECOMMENDATION - 7

Requirements Process

Specific Actions (I.e., infrastructure desirements) that
Common Data Environment
mediately to begin to build the infrastru

- **hort-term progress toward the**
  Grid and the JBI
  1. **Require ALL syste**
     identify the inform
     build the XML repr
  2. **Require ALL comm** **systems to**
     interface tha **ables the use of**
     IP standards
  3. **ALL decision and information-**
     g elements to be addressable
     usi internet addressing standards (I.e.,
     define AF C2 URLs)
  4. **Require ALL systems accessed for C2**
     purposes to have a "browser" interface
- **The C2IO should task ESC, immediately,**
  to build the roadmap for achieving this
  first instantiation of the integrated

Common Communications Environment

Web-enabled and "first-order integration"

Other Case Studies

Three other studies show findings similar i
principle to Cisco.

- **Sears Roebuck and Co.**
  HBS 9-191-015, October 6, 1992
- **XEROX**
  HBS 9-195-158, September 5, 1996
- **Symantec**
  HBS 9-196-011, September 20, 1996

- Cisco Employee Connection (CEC) supports instant global communications among Cisco employees worldwide
- Virtually every application in the company uses a web browser as its only interface
- Distance learning modules can be activated at the employee's desktop
- Enables the use of "streaming video" to strengthen the linkage between corporate leadership and employees
- Cisco employees use the web browser as a front end for access to

CISCO SYSTEMS, INC. -5

- **Cisco's Supply Chain Initiative** *Requirements Process*
  - **used networked applications to integrate suppliers into its production system, creating a "single enterprise"**
  - **a Cisco study showed new applications required as many as four or five iterations of prototype building so they automated the collection of new product data**
  - **testing processes were automated and standardized with the result that it was outsourced to suppliers**
  - **a dynamic replenishment model was implemented that allows the market demand signal to flow directly to the contract manufacturers without any distortion or delay**

CISCO SYSTEMS, INC. -6

- **Some concluding observations**

  - **Cisco centrally manages <u>all</u> of its IT from a technical point of view**
    - **CIO responsible for the architecture, the technology standards, the cost effectiveness, and the development approach**
    - **Sorvik states “the most important part of our IT mission is to improve Customer Satisfaction”**
    - **Corporate G&A maintains the IT infrastructure but the business functions decide how they are going to invest the IT money for their most-valued applications**
    - **A Cisco study showed the centralized IT development saves as much or more than the actual costs (I.e., effectively**

Other Case Studies - 2

- **Sears developed a concept of a Corporate Information Technology Utility and stated**

"What is needed is an organization that would provide community planning and zoning, a unified building code, and common services for the various distinct and individual residences. Just as these residents would not be concerned with the technicalities of how fuel, water, electricity telephone, fire, and police protection were provided, application systems developers would be able to take the technological infrastructure for granted, knowing that it was already there- part of a shared, less costly organization that allows them to concentrate on the business application system, not the supporting technology. Of course, business groups must accept the requirement to conform to certain

Other Case Studies - 3

- To address IM (and IT) problems, Xerox started the IM 2000 reengineering project in mid-1993
  - The IM 2000 design team recommended specific strategies to fix the problems they found:
    - reduce overall costs by reining in the expense of legacy systems
    - move to an industry-standard infrastructure that would be managed centrally in order to increase interoperability and sharing of solutions and information worldwide
    - create a library of shareable core modules, centrally developed or purchased which could be used locally to create solutions
    - retire or replace legacy systems with solutions to support new business

Other Case Studies - 4

- **Symantec, for example, states that they "will employ an information architecture that supports the migration to distributed client-server computing and promotes direct end-user access to enterprise information"**
- **The information architecture "will**
  - **Use a network-centric 'information repository" as a secure source of corporate master files/or shared departmental data files**
  - **Define a common data dictionary and terms-definition facility for repository data elements**
  - **Permit network access to 'repository' information by both distributed and mid-range applications**
  - **Permit common access for end-users via a standard corporate desktop**

What is a Requirement?

- **CJCSI 3170.01**
  - **The need of an operational user, initially expressed in broad operational capability terms in the format of a MNS. It progressively evolves to system-specific performance requirements in the ORD**

- **AFI 10-601**
  - **A recommended solution to a mission deficiency that when validated and approved, justifies the timely allocation of resources to achieve capability to accomplish military objectives**

Note that the concept of a common infrastructure is buried in these definitions and easy to ignore!

Why Document Requirements ?

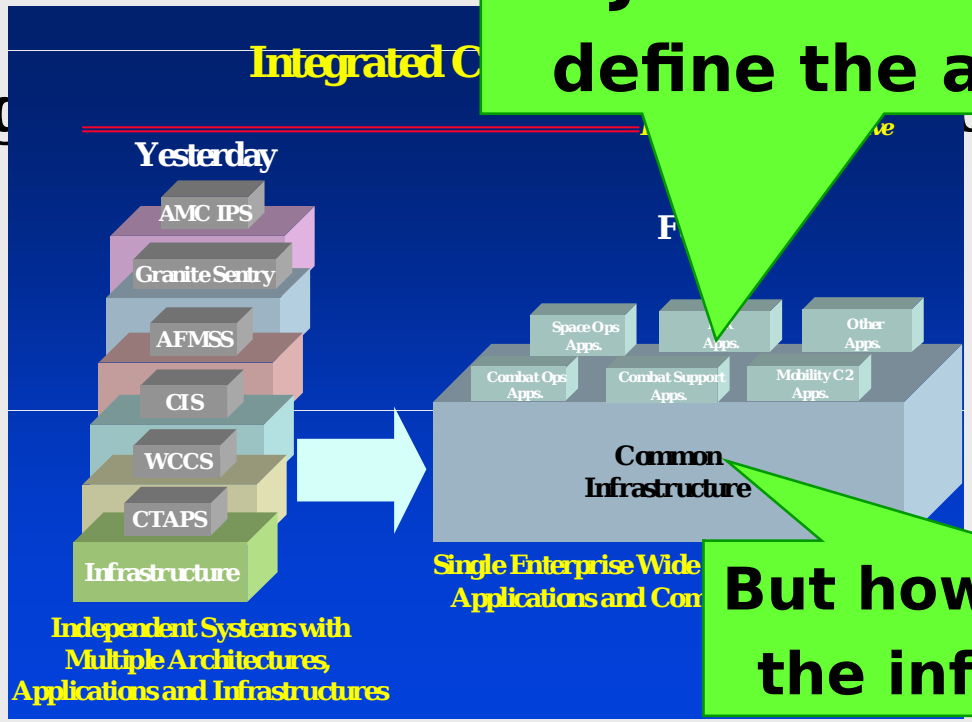
- **Provide Guidance to Developers & Testers**
- **Document Solution to a Materiel Deficiency**
- **Assist in Making Informed Investment Decisions**

For C2, who defines the requirement for a common infrastructure? Difficult to imagine i being defined by a MAJCOM (I.e., a business un

C2 VISION - OUTLINE OF THE IC2.COM

Requirements Process

The ic2.com will be web-like using the integration of commercial IT system systems, including systems



MAJCOMs and Functionals define the applications

But how do we build the infrastructure?

mon Infrastructure Increases Integration and Affordal

C2 VISION - THE WAY AHEAD

Requirements Process

- Need to build a more collaborative working relationship among operators, acquirers, engineers, technologists, testers, trainers and industry
- To create a common infrastructure, responsibilities must be defined that cut across MAJCOM and organizational boundaries
- Commercial IT is a “disruptive technology/capability” that DOD and AF business process “rhythms “ have a difficult time accommodating (e.g., requirements creation and maintenance, funding delays, programming and planning complexities, acquisition and program restrictions, …)

w business processes must be defined and implemente
enable the effective use of these “disruptive technolog

Infrastructure
(Component View)

Common Operating Env
Shared Services

- Enterprise Mgmt
- Messaging
- E-mail
- Office Automation
- Distributed Compu
- Alerts
- Web Services
- Development Toolkits
- Collaboration
- Mail Security

Common Data Env

- Physical Data Mgmt
- Shared Data Access
- g/Migration
- blish & Subscribe
- Secure Data Storage Metadata

Common Comm Env

- Wide Area Networks (WAN)
- Local Area Networks (LAN)
- Complex Circuits
- tivity
- .)
- ridges
- Switches/Radio/Crypto
- SATCOM (Ground, Air…)
- Firewalls

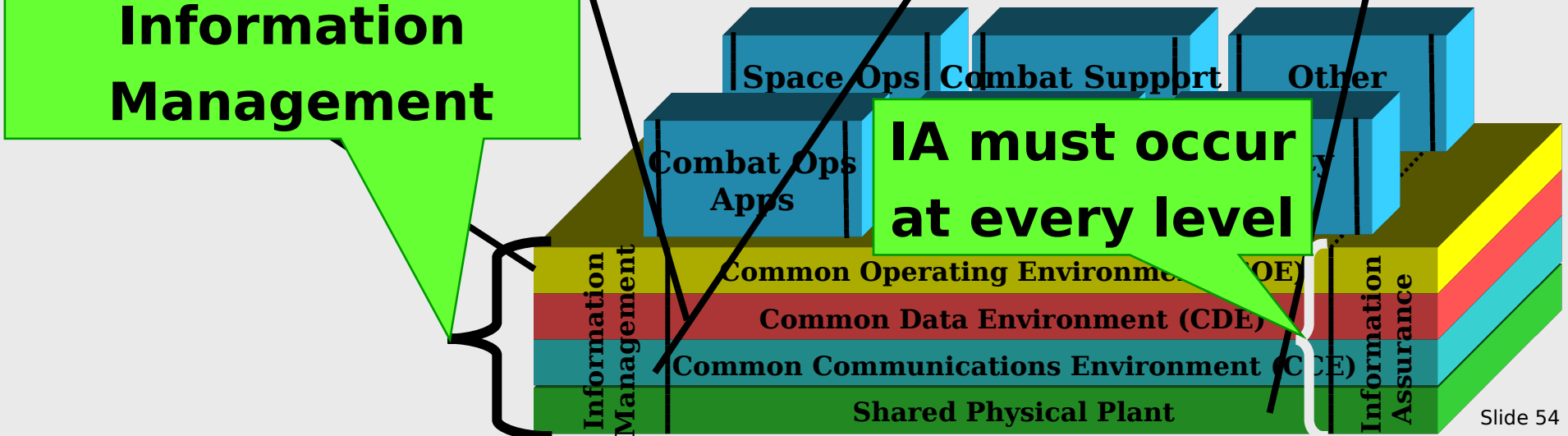
Shared Physical Plant

- Process/Display Units (workstation clients, servers, . . .)
- Shared Devices
- Common Media (CD ROM, Tape, . . .)
- Connectors (DB25, Cannon Plug, . . .)

Provides a web-based integrated system

Use JBI to perform Information Management

IA must occur at every level



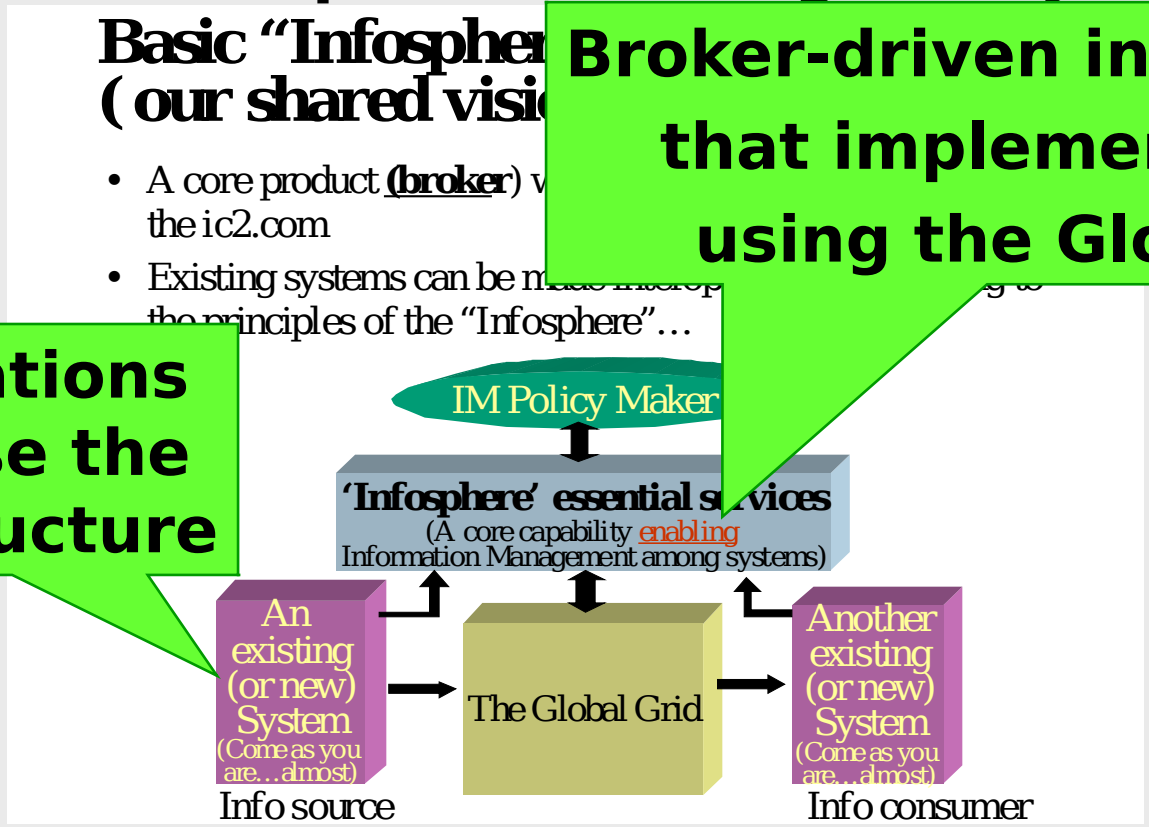
C2 VISION - INFORMATION MANAGEMENT = JBI

Requirements Process

Information management in the ic2.com will be accomplished through the JBI

Broker-driven infrastructure that implements the JBI using the Global Grid

Applications must use the infrastructure



Implementation of the JBI is beginning and requires the participation of the entire AF community

JBI Basics

The JBI is a system of systems that integrates, aggregates, & distributes information to users at all echelons, from the command center to the battlefield.

The JBI is built on four key technologies:

- **Information exchange**
  - **Publish/Subscribe**
- **Transforming data to knowledge**
  - **“Fuselets”**
- **Distributed collaboration**
  - **Shared, updateable knowledge objects**
- **Force/Unit interfaces**
  - **Templates**
    - **Operational capability**
    - **Information inputs**
    - **Information requirements**

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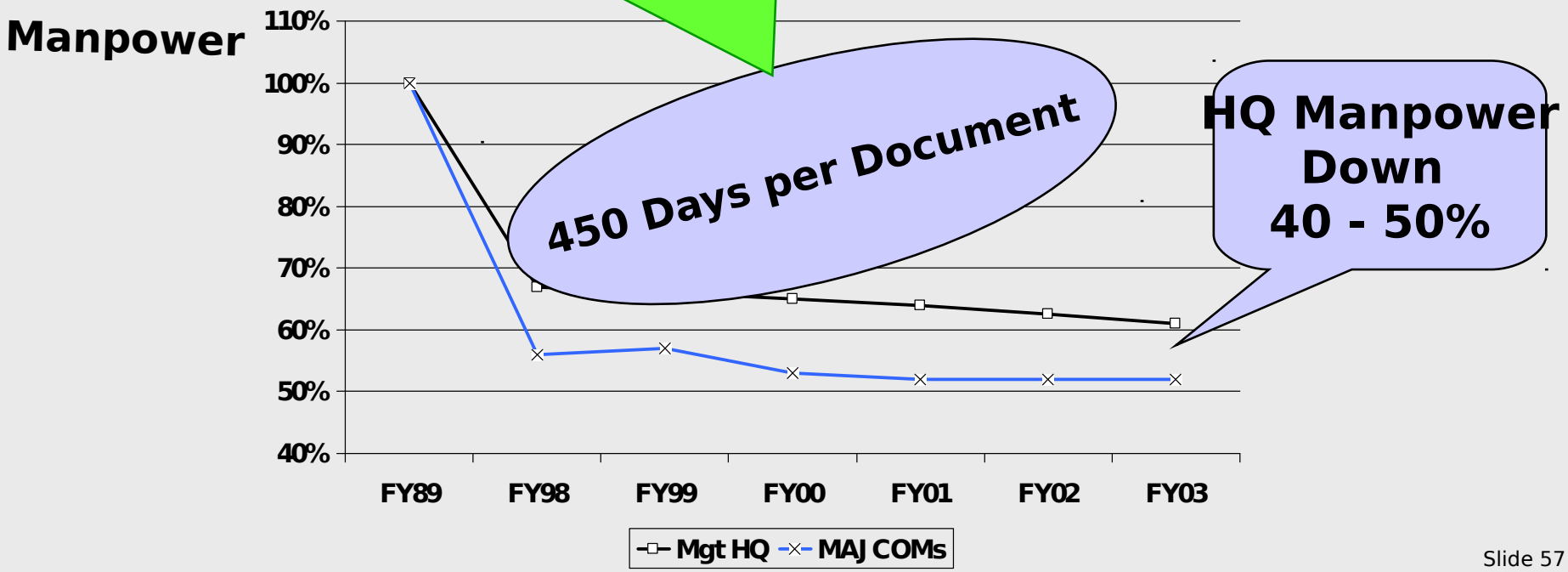

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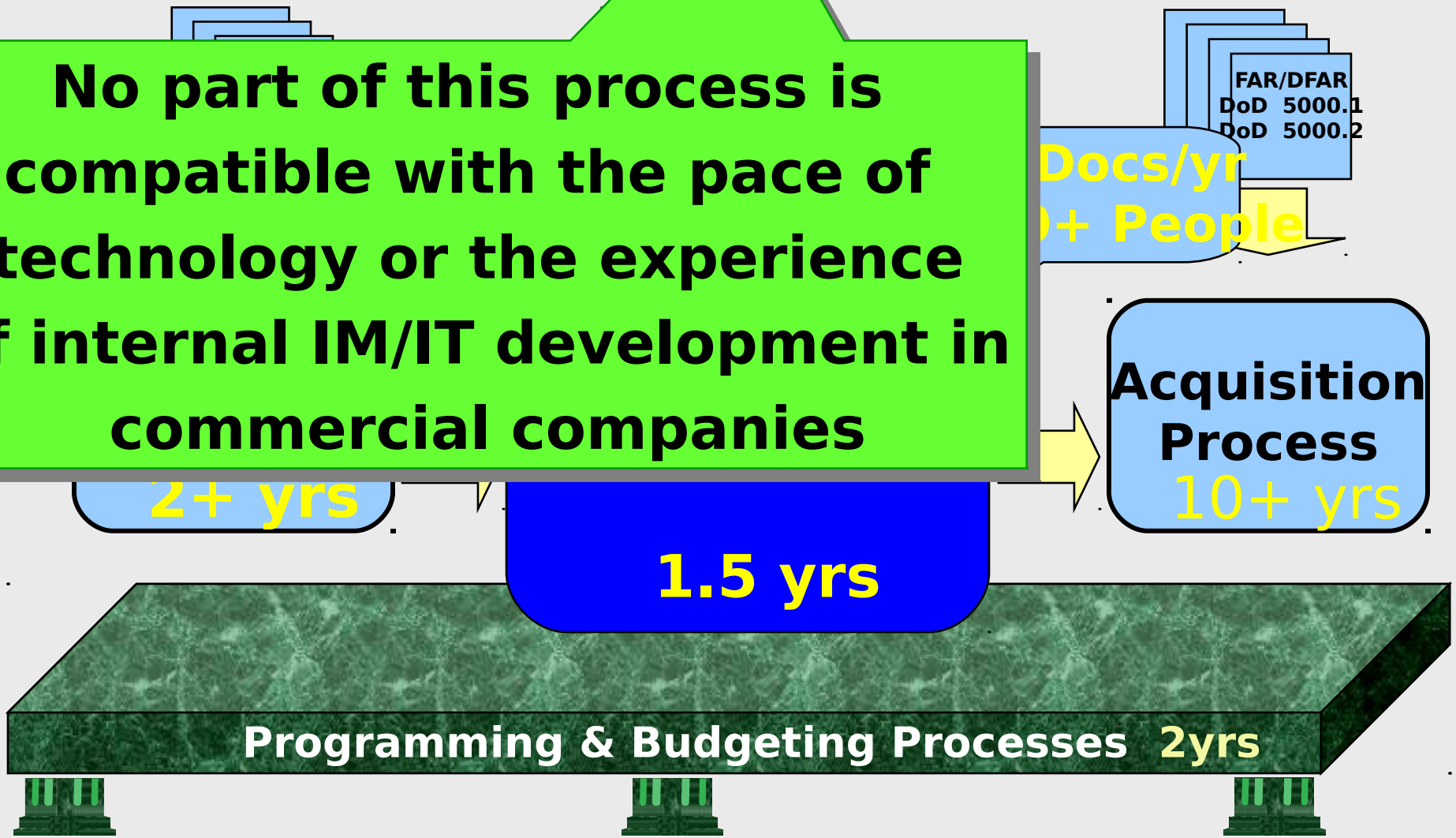
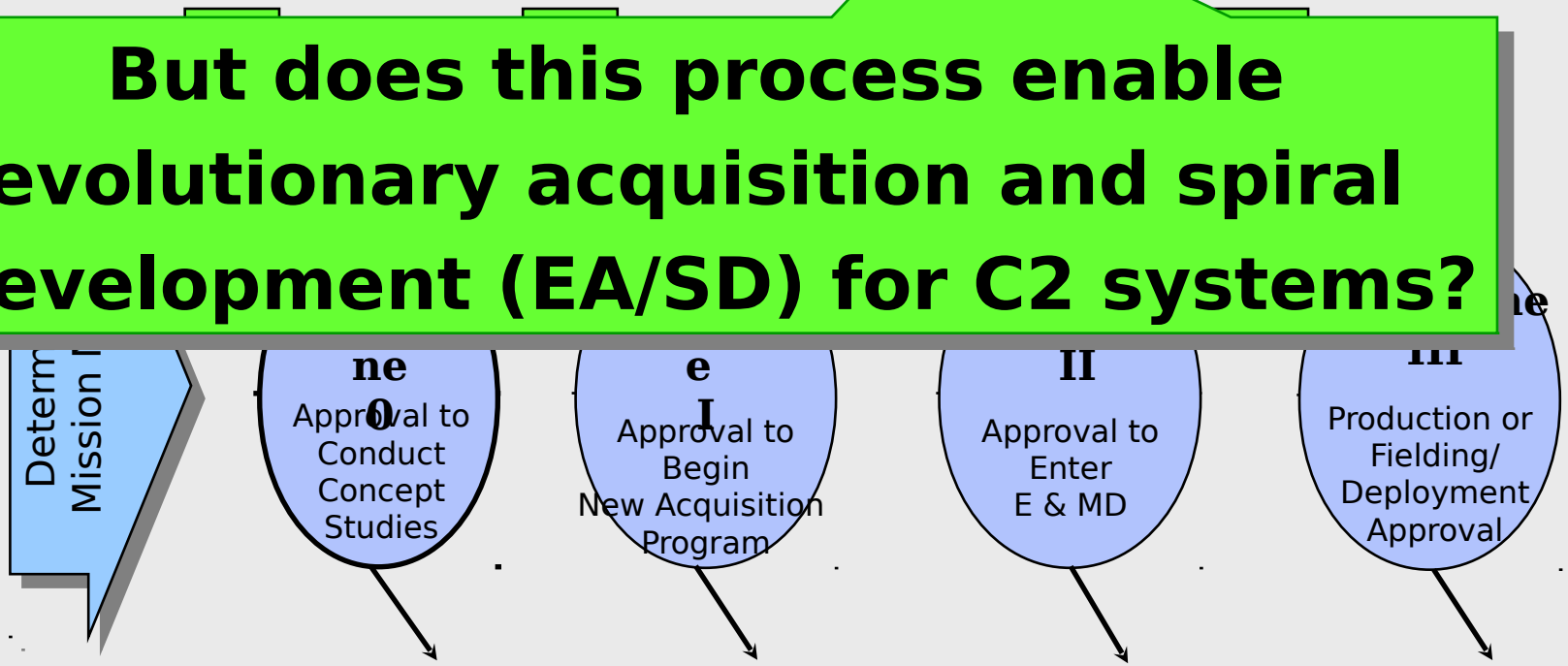


Milestones & Phases: The 5000 Process

Requirements Process

But does this process enable evolutionary acquisition and spiral development (EA/SD) for C2 systems?



Pre-Phase 0 Activity	Phase 0	Phase I	Phase II	Phase III
	Concept Exploration	Program Definition & Risk Reduction	Engineering & Manufacturing Development	Production, Fielding/Deployment, and Operational Support
Planning	Requirements Generation		Acquisition	

Common Integrated Infrastructure
(Funding Requirement -- $M)

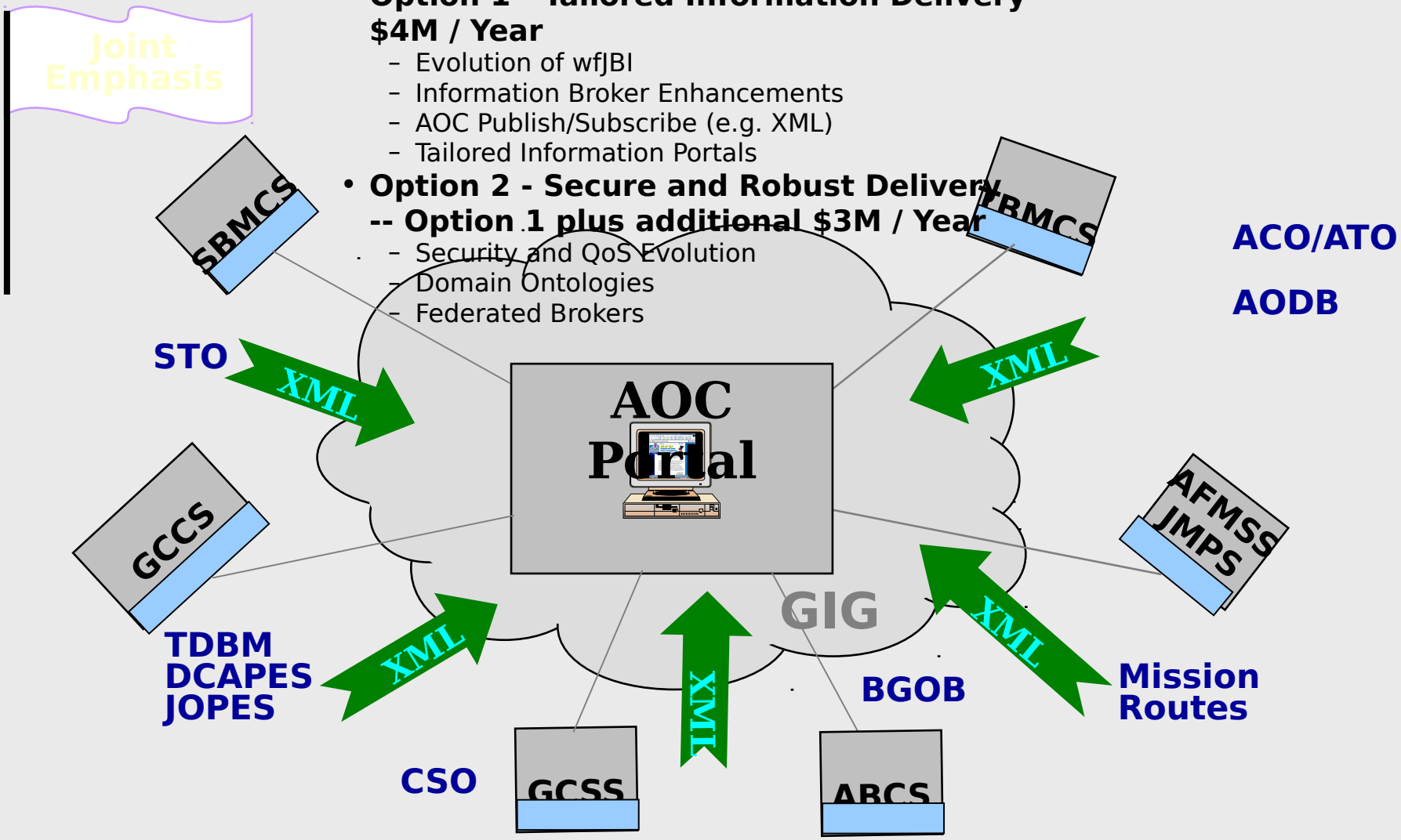
Requirements Process

ITEM	FY0n	FY0o	FY0p	FY0q	FY0r	FY0s	FY0t
Planning, Pilot Development & Testing	60	60	20	20	20	20	20
Implement across existing AF capabilities							
• IM	100	150	150	0	0	0	0
• Comm	50	75	125	0	0	0	0
Required Funding	210	285	285	20	20	20	20
Add new capabilities (i.e., primarily to include more fiber, more Link 16, JTRS)	Many $B over the FYDP						

Enabling the JBI Air Component

Requirements Process

- **Option 1 - Tailored Information Delivery $4M / Year**
  - Evolution of wfJBI
  - Information Broker Enhancements
  - AOC Publish/Subscribe (e.g. XML)
  - Tailored Information Portals
- **Option 2 - Secure and Robust Delivery -- Option 1 plus additional $3M / Year**
  - Security and QoS Evolution
  - Domain Ontologies
  - Federated Brokers



Option 1
Tailored Information Delivery

Requirements Process

- **Identify data production requirements (by system)**
- **Develop Data Schema**
- **Encode XML/DTD**
- **Establish DB/Warehouse (if appropriate)**
- **Publish Data**
- **Identify information consumer requirements**
- **Integrate wfJBI Information Broker**
- **Develop data producer profiles**
- **Develop/Integrate AOC fuselets**
- **Develop data consumer profiles**
- **Integrate wfJBI information/visualization portals**

ROM Estimate = $4M / Yr

Option 2
Secure and Robust Delivery

Requirements Process

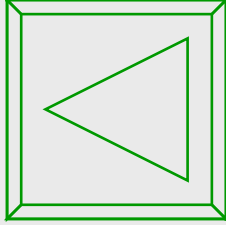
Option 1

- Identify data production requirements
- Develop Data Schema
- Encode XML/DTD
- Establish DB/Warehouse (if appropriate)
- Publish Data
- Identify information consumer requirements
- Integrate wfJBI Information Broker (IB)
- Develop data producer profiles
- Develop/Integrate AOC fuselets
- Develop data consumer profiles
- Integrate wfJBI information/visualization portals

- **Integrate application portals**
- **Develop/Integrate advanced IB capabilities**
  - **PKI-enabled Information Portals**
  - **Certificate-based Access Control**
  - **End-to-End Security**
  - **Priority-based Delivery**
  - **Guaranteed/Assured Delivery**
  - **Bandwidth-on-Demand / Timeliness of Delivery**
- **Federated Brokers**
- **Information Object Exchange**
- **Domain Ontologies**

ROM Estimate = Option 1 plus $3M / Yr

JBI Way Ahead Schedule



- Architecture, standards and roadmap development-ongoing
- Activate JBI Testbed nodes- 1Q01
- Transition wfJBI to Testbed-2Q01
- Field initial Air Component JBI -3Q01
- Activate joint JBI Testbed nodes-1Q02
- Transition YJBI to Testbed-2Q02
- Experiment with YJBI at EFX02-4Q02
- Field enhanced Air Component JBI -4Q02